# RECENT HUMAN HEALTH PROBLEMS IN CALIFORNIA ASSOCIATED WITH EXPOSURE TO PENTACHLOROPHENOL DURING 1975 THROUGH 1977

by

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## SUMMARY

Pentachlorophenol (penta) and its sodium salt are used as contact herbicides, fungicides, molluscicides, and wood preservatives. They are absorbed rapidly by dermal contact, inhalation, or ingestion. Applicators are usually exposed to dilute solutions which do not cause severe injuries. There were 42 cases of occupational injury or illness reported by California physicians in the years 1975 through 1977. The greatest number were cases of dermatitis and conjunctivitis, with only 9 systemic illnesses. All the injuries responded well to treatment with no serious sequelae. In most cases, proper handling of the pesticide and use of proper safety equipment could have prevented these injuries. Studies on the possible long-term effects of repeated exposures have been under scrutiny by the Environmental Protection Agency because penta usually has low concentrations of hexachlorodibenzo-p-dioxin and hexachlorobenzene present as impurities. Based upon studies in test animals, it appears that excessive exposure to pentachlorophenol may carry some low risk of oncogenicity, fetotoxicity, and teratogenicity. Users should be advised to minimize exposure by using maximal protective measures.

## INTRODUCTION

Pentachlorophenol (PCP) is produced by the chlorination of phenol at high temperatures, a procedure which also produces a small amount of hexachloro and octachloro derivatives of dibenzo-p-dioxin, but not the tetrachloro compound (TCDD). It is a crystalline solid which is insoluble in water and is sold as a solution in a hydrocarbon solvent. The major use in California is in the treatment of lumber, and its agricultural use in 1978 was 650 pounds as a herbicide, sometimes combined with other compounds such as 2,4-D, Bromocil, and Prometon. PCP is rapidly absorbed through the skin and mucous membranes, and by inhalation and ingestion. In industry, inhalation of the vapor or dust is the most common cause of poisoning, while the dermal route is probably the most common in agricultural workers. Contact with the skin and eyes causes a burning pain which can become severe if not washed off at once. Workers are not aware that careless handling of the more concentrated solutions can result in systemic illness due to the fact that it has the biochemical effect of uncoupling cellular oxidative phosphorylation and the resultant increase in metabolic rate. Symptoms of mild poisoning are muscular weakness, anorexia, and lethargy. Moderate toxicosis involves accelerated respiration, hyperpyrexia, hyperglycemia, glycosuria, sweating, and dehydration. The next stage is muscular and cardiovascular collapse, convulsions due to anoxia, coma, and death. The pathological changes are lung edema and moderate changes in the liver and kidney cells. PCP is partially metabolized and rapidly excreted in the urine, with about half the amount in the body being excreted in 24-36 hours. For this reason, there is little tendency for chronic toxicity in agricultural workers where exposure is intermittent and concentrations are low. In areas like Hawaii, however, where usage is high and the general public can frequently contact treated wood, the urine of the general public contains low levels of PCP. This caused concern that there might be serious effects from such long-term exposure. Some laboratory studies have shown that commercial grade pep may be oncogenic, fetotoxic, and teratogenic. These effects may be due to the hexachlorodibenzo-p-dioxin and hexachlorobenzene (HCB) present as impurities. Some scientists disagree that penta is teratogenetic or fetotoxic because the dose levels used were in the acutely toxic range for the animal. Furthermore, it was pointed out that the purified PCP, which contains no dioxins, is more fetotoxic than the commercial product.

There were 42 reports of pesticide injuries by California physicians in the years 1975, 1976, and 1977. Nine were systemic, 6 of which were due to treating wood or handling treated wood. Nine had a dermatitis or chemical burn, 7 of which were due to treating wood. There were 24 eye injuries, 12 of which were due to treating wood. All these injuries were mild and responded to treatment without the loss of more than a few days from work. The injuries were due to failure to use protective clothing, careless handling of the equipment, or equipment failure, and could have been prevented by proper instruction and supervision of the workers.

## TECHNICAL INFORMATION

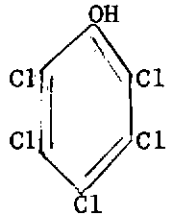
Chemical name : Pentachlorophenol

Common names : PCP, penta

Trade names : Dowicide 7, Noxtane, Pentacon. Weedone, Woodlife, and Woodtreat

Basic producers : Dow Chemical Company, Monsanto Chemical Company

Chemical structure :




Physical properties: Buff color crystals, melting point 174°C ($1 H_2O$), 191°C (anhydrous), soluble in organic solvents, B.P. 203°C, MW 266.4, density 1.85. The water solubility is 18 ppm, but its alkali salts are very soluble. Vapor pressure 5.5 mm Hg at 160°C.

### Composition of Commercial Pentachlorophenol[1/]

| Component | COMMERCIAL (Dowicide 7) | PURIFIED (Dowicide EC-7)[2/] |
|---|---|---|
| Pentachlorophenol | 88.4% | 89.8% |
| Tetrachlorophenol | 4.4% | 10.2% |
| Trichlorophenol | < 0.1% | < 0.1% |
| Chlorinated phenoxyphenols | < 6.2% | - |
| Hexa-dioxins | 4 ppm | 1.0 ppm |
| Hepta-dioxins | 125 ppm | 6.5 ppm |
| Octa-dioxin | 2500 ppm | 15.5 ppm |
| Hexa-furans | 30 ppm | < 1 ppm |
| Hepta-furans | 80 ppm | 1.8 ppm |
| Octa-furan | 80 ppm | < 0.1 ppm |

[1/] Data from Dow Chemical Company
[2/] Total greater than 100% because numbers are rounded off

The technical product is 85%, containing other chlorophenols and hexa- and octa-chlorodioxins (HCDD and OCDD). It does not contain 2,3,7,8-tetrachlorodibenzodioxin (TCDD). It is degraded in soil by hydroxylation.

Action : It is a herbicide, a fungicide, an insecticide, and a molluscicide.

Use : Wood preservative, molluscicide, wide-range weed killer.

Formulations: Pentachlorophenol is mixed with hydrocarbon solvent such as mineral spirits, No. 2 fuel oil, or kerosene. PCP is also available as an emulsifiable concentrate. It is also combined with other herbicides such as Bromocil, 2,4-D, methoxy-5-triazine and prometon.

Toxicity : Acute oral $LD_{50}$ (rat) 50-140 mg/kg
Acute dermal $LD_{50}$ (rabbit) 200 mg/Kg
Inhalation $LC_{50}$ (rat) 5 mg/liter

Single Oral $LD_{50}$ of Dioxin Isomers[1/]

| Isomer | $LD_{50}$ µg/kg | |
|---|---|---|
| | Guinea Pigs | Mice |
| 1,2,3,4,7,8-HCDD | 72.5 | 825 |
| 1,2,3,6,7,8-HCDD | 70-100[2/] | 1250 |
| 1,2,3,7,8,9-HCDD | 60-100[2/] | 1440 |
| 1,2,3,4,6,7,8-HCDD | 7180 | - |
| TCDD[3/] | 2 | 263.7 |

[1/] Data from McConnell et al. (1977)
[2/] Estimated range represents variability among replicates
[3/] TCDD values are shown for comparative purposes

## OCCUPATIONAL EXPOSURE INCIDENTS REPORTED IN CALIFORNIA IN 1975

In 1975, there were 20 incidents of occupational exposure to pentacholorophenol reported by physicians to the California Department of Food and Agriculture. Of these, 3 resulted in systemic illnesses, 11 involved eye exposure, and 6 were skin exposure incidents. The following is a review of these incidents.

### Suspected Systemic Illnesses

A worker was installing benches when the crystalized finish containing pentachlorophenol blew into his face. The employer had not provided safety equipment or precautionary instructions. The worker's eyes, ears, nose, and throat were irritated. In addition, he reported that his voice changed. He was examined, treated, and released by a physician. One day of work was lost.

While installing wooden benches, a carpenter was exposed to pentachlorophenol. Exposure resulted from both skin contact and inhalation of vapors around the benches. Reported symptoms included eye and nose irritation and a headache. No safety equipment was provided by the employer although the worker wore a respirator for the last 2 days of the 3-day job. The benches had been treated with Never Rot 3 weeks prior to installation, and had also been painted with an exterior enamel. Neither the employer nor the employees were aware of any potential health hazards from the treated wood. The worker was examined and treated, and the diagnosis was reported as toxic rhino-laryngo-tracheitis due to chlorinated hydrocarbon exposure.

A gardener developed headaches and a chronic cough while working for 3 weeks in an enclosed greenhouse. She had applied pentachlorophenol extensively to the walls and benches, and continued to work in the greenhouse immediately thereafter. A physician diagnosed her illness as a reaction to the wood preservative, and treatment was given. No safety equipment was provided, and precautionary statements on the label were not followed. The employee had not been told the name or the nature of the material she was using. The greenhouse was later repainted because the fumes were damaging the plant leaves.

### Skin Exposure

A laborer working with a wood preservative containing PCP developed a rash on his forearms and left leg. He went to a physician the same day. The problem was diagnosed as an allergic reaction, and treatment was provided. The worker was wearing gloves, but his forearms were exposed.

A worker was cleaning a pressurized sprayer when some Triox leaked onto his face and hand. No illness resulted. A physician examined him, washed the affected areas, and gave treatment. Gloves and facial protection might have prevented this injury.

A worker developed a skin irritation while stacking lumber treated with Noxtane (PCP). The injury was diagnosed as contact dermatitis. Aristocort cream was prescribed as treatment.

A truck driver developed a skin irritation handling lumber which had been treated with Woodlife Wood Preservative. Two days later, he developed a rash and sought medical aid. Dermatitis with associated edema and erythema was diagnosed. Topical medications and injections were given to treat the injury. The incident was attributed to a probable allergic reaction. No safety equipment had been provided or worn, and the employer did not advise the employee of safety procedures.

A painter developed a skin rash 2 weeks after spray painting with Woodlife Wood Preservative. A physician diagnosed and treated the condition. Masks were provided and worn, but protective clothing was not used. The report did not indicate if protective clothing was provided, but the painter was warned to keep the preservative off his clothing.

A millwright spilled Noxtane on himself while lifting an open 5-gallon bucket containing the chemical. He did not change clothes until later in the day. His skin developed scaling, blistering, and erythematous eczema-like eruptions. He was treated with Synalar lotion and told to avoid further contact with Noxtane. Gloves were the only safety equipment used. A face shield and protective clothing were not provided. Adequate instruction and supervision appear to have been lacking. Hand-lifting and mixing were necessary because Noxtane apparently destroyed the rubber and plastic parts of the closed system transfer equipment previously used.

Eye Exposure

A laborer was dipping timbers in a barrel of PCP and creosote. A timber slipped and fell into the barrel, and some of the material splashed into his eye. The eye was washed with water and the worker was taken to a hospital emergency room. The case was diagnosed as chemical conjunctivitis. The worker was treated with a saline irrigation, ointment, and a patch. Eye protection and rubber gloves were provided but apparently not worn.

A gardener was filling a 3-gallon Hudson-type sprayer with a weed killer containing pentachlorophenol when the material splashed in his face. He immediately flushed his eyes with water. A physician examined the eyes and diagnosed the injury as chemical conjunctivitis. No treatment was reported. No safety equipment was provided or worn.

A worker was painting an overhead wood beam with Woodtreat when he was startled by another person in the house causing the worker to spill some of the material in his eyes. A physician diagnosed the injury as chemical conjunctivitis in both eyes. Treatment included saline irrigation, Pontocaine, and Cortisporin ointment. No safety equipment was required by the product label, but a hard hat, a respirator, and goggles were provided. The worker wore only the hard hat.

A maintenance worker was spraying weed killer (Triox) when his Hudson-type sprayer came apart, splashing him in the face and causing an eye irritation. He was examined, treated, and released. The worker was not familiar with either the use of the Hudson-type sprayer or the weed killer being applied.

A custodian was emptying a Hudson-type sprayer when the wind changed, spraying a fine mist of Certifan into one eye. The diagnosis was chemical conjunctivitis, and the eye was irrigated. No other treatment was given. It was not reported if safety equipment was provided or used. The accident was attributed to carelessness.

A laborer was drilling holes in poles to test penetration of previously applied Cellon (pentachlorophenate). It was raining and some Cellon splattered into his left eye. The worker did not wash his eyes and did not report the injury or go to a doctor until 11 days later. The physician diagnosed the injury as edema, and the condition was treated with an unspecified medication. Eye protection had been provided but was not used.

A worker was applying wood preservative from a spray gun when the gun exploded, causing particles to spray into his eyes. The injury was diagnosed as chemical conjunctivitis. Medication was administered. It was not reported if safety equipment was provided or used. The accident was attributed to equipment failure.

A worker was rolling wood preservative on an overhead surface when some of the liquid fell into his eyes. He washed his eyes promptly and consulted a physician. The diagnosis was chemical conjunctivitis, and treatment was provided. It was not reported if safety equipment was provided or used. The accident was attributed to carelessness by the worker.

A plumber was dipping wood blocks in a solution of Chevron Wood Preservative. Some of the preservative splashed into his right eye. The eye was examined and irrigated by a physician. Rubber gloves were provided and worn by the worker. The label warned against spilling the material on the eyes, skin, or clothing, but no safety equipment was specified.

A factory worker was filling a 50-gallon drum with sodium pentachlorophenate through a hose connected to a mixing tank. When the drum became full, some of the chemical splashed into his right eye. The injury was diagnosed as chemical conjunctivitis. The eye was irrigated, treated with medication, and covered with a patch. Goggles and rubber gloves were provided, but only the gloves were worn. The employer apparently did not insist that the worker use safety equipment. The product label also made no mention of safety equipment.

An employee splashed a concentrated pentachlorophenol solution into both eyes. He developed bilateral chemical burns of the eyes. A physician treated the injury with Opthaine drops and Cortisporin ointment. No information on safety equipment was provided. One-half day of work was lost.

## OCCUPATIONAL EXPOSURE INCIDENTS REPORTED IN CALIFORNIA IN 1976

In 1976, there were 8 incidents of occupational exposure to pentachlorophenol reported by physicians to the California Department of Food and Agriculture. Of these, 3 resulted in systemic illness, 4 involved eye injuries, and 1 was a skin injury.

### Suspected Systemic Illnesses

Two clerks were exposed to Vigoro Weed and Grass Killer fumes for 2 hours while trying to clean up a spill of the material. Both developed headaches, chest pains, and feelings of general malaise. They were examined, treated, and released by a physician. Details are not clear but apparently the clerks were involved with retailing the pesticide. No safety equipment was provided. In addition, the clerks were unaware of the dangers in breathing or contacting the pesticide.

A worker allowed fumes to blow around his face while spraying Triox with a Hudson sprayer. He later felt tired and had difficulty breathing. Examination and X-rays by a physician showed the the worker had Valley Fever (coccidioidomycosis). He was treated accordingly. The pesticide inhalation may have aggravated his primary condition of Valley Fever. No safety equipment was provided, nor was the worker cautioned about using the pesticide. Several days of work were lost.

### Skin Injuries

While treating the underside of a house with Woodtreat, a worker allowed the material to run down his arms, burning his skin. The injury was diagnosed as cellulitis of the skin, and treatment was prescribed. It is not known if safety equipment was provided or worn, or if the employee was advised of safety procedures.

### Eye Injuries

A hose broke while a gardener was spraying weeds with Triox, causing the chemical to splatter into his eyes. A physician examined and treated the worker. It was not stated if safety equipment was provided, or if he was advised of safety procedures.

A gardener was spraying with Fenocil when some of the spray contacted his face. A doctor diagnosed the injury as chemical conjunctivitis. The gardener was treated and released. No report was made of any safety equipment or instruction in safety procedures.

Two men were working on adjacent properties belonging to different employers. One was cutting weeds; the other was spraying weeds with Triox. The hose broke on the sprayer, causing the other worker to be sprayed in the face. He was taken to a doctor and the injury was diagnosed as mild conjunctivitis; he was treated and released. It is not known if either man was provided with or used safety equipment. Carelessness on the part of the applicator in working so close to another person undoubtedly contributed to the accident.

While spraying weeds with Triox, a hose broke, causing the material to spray into the worker's eyes. He flushed his eyes with water and consulted a doctor. Moderate conjunctivitis in both eyes was diagnosed. The eyes were irrigated, and Neodecadron was used to treat the injury.

## OCCUPATIONAL EXPOSURE INCIDENTS REPORTED IN CALIFORNIA IN 1977

In 1977, there were 14 incidents of occupational exposure to pentachlorophenol reported by physicians to the California Department of Food and Agriculture. Of these cases, 3 resulted in systemic illnesses, 8 involved eye exposures, 2 involved skin injuries, and 1 involved a combined skin and eye injury.

### Suspected Systemic Illnesses

A construction worker developed a cough and nasal congestion after being exposed to Woodlife Wood Preservative. The examining physician diagnosed his illness as probable chemical pneumonia with secondary asthma. The worker was treated and released.

While spraying Ortho Triox Vegetation Killer, a maintenance man inhaled some of the chemical. He became dizzy and nauseated and was taken to a physician, who treated and released him.

Over a period of several weeks, a structural pest control worker was exposed to wood treatments containing pentachlorophenol. His job required him to do some application, but his main job was termite inspection. A routine physical examination disclosed abnormalities in his liver function tests. He was treated and told to stay away from chemicals at work. The physician was not sure if the illness was pesticide related.

### Skin Injuries

While applying Woodlife Woodtreat to lumber, a painter spilled some of the material on his right foot. He did not wash the affected area, and continued working. Later a chemical burn developed on his foot, and he consulted a physician. He was treated and released. This injury could have been prevented had the painter stopped to wash his foot.

A worker, experienced in pesticide use, was spraying weeds with a pesticide containing a small amount of pentachlorophenol. The hose clamp came loose at the gun, spraying part of the worker's body with the chemical. Full protective equipment (goggles, boots, gloves, respirator, apron) was used but some of the chemical still managed to contact the skin, causing third degree burns. A physician treated and released the worker. The hose clamp was later examined and found to be defective.

### Eye Injuries

While spraying Triox, a shift in the wind caused some spray to blow into a worker's eyes. Moderate conjunctivitis of both eyes resulted. Medication was administered and the worker was released.

A lumber company employee was treating freshly cut lumber with a concentrated solution of pentachlorophenol when some of the chemical splashed into his eyes. A physician examined him and diagnosed the injury as conjunctivitis. The worker was given medication and released. The injury was estimated to require 2 days of disability.

A temporary employee was working for a structural pest control operator, applying a solution of Penta-5 to new flooring. While spraying the chemical, he got some on his hands and did not wash them. He later rubbed his eyes and, as a result, developed chemical conjunctivitis. A physician irrigated the eyes and administered medication. Goggles were provided and apparently worn while spraying. The employee had received little training in pesticide application. One day of work was lost.

While spraying Triox, a small amount splashed into a worker's left eye. He was examined, treated, and released.

A lumber company worker was employed to dip boards in a solution of pentachlorophenol. While filling a container with the chemical, some splashed into his eye. A physician irrigated the eye and administered medication. Goggles and rubber gloves were required by the label, but only the gloves were provided by the employer.

A school district gardener had filled a Hudson-type sprayer with a solution of Fenocil and was pressurizing it. The hose broke at the tank connection, and the chemical sprayed into his eyes. He flushed his eyes and consulted a physician, who applied Neosporin drops. The employee's supervisor stated he was unaware that the gardener was using a pesticide as he had not been trained to do so. A notice of violation of the Food and Agricultural Code was issued to the employer.

A worker attempted to remove the top of a Hudson-type sprayer without depressurizing it. The top came off suddenly, spraying a solution of Parch herbicide containing PCP into the worker's face and eyes. A physician diagnosed the injury as bilateral chemical conjunctivitis. Eye drops and ointment were administered.

A worker was employed to receive logs coming out of a dip tank containing Kenite-9. Some of the chemical splashed in his eye when he dropped a log onto other freshly dipped logs. He was examined and treated by a physician. The worker was provided with gloves and a face shield, but chose to wear only the gloves. The employee had not been given adequate instruction in the use of pesticides; the employer was not even aware that the material was a pesticide. A notice of violation of the Food and Agricultural Code was issued to the employer. One week of work was lost.

Skin and Eye Injury

After spraying weeds with Triox, a maintenance man began to open his Hudson-type sprayer, thinking it was empty. The pressure inside caused some remaining Triox to spray up into his face and eyes. He was taken to a physician, treated for chemical conjunctivitis and dermatitis, and released. A face shield could have prevented this injury. One day of work was missed.

## DISCUSSION

### Acute Effects

A review of the 42 cases of PCP injury reported by California physicians shows there were only 9 workers who absorbed a sufficient amount of PCP to cause mild symptoms of systemic toxicity, and 6 of them were exposed while treating wood or handling treated wood. Presumably, the main route of absorption was dermal while in the case of workers spraying the material as an herbicide, it could be both by inhalation and dermal exposure. The short duration of the resulting illness indicates there was rapid excretion of the toxicant. Begley (1977) studied the mean values of PCP in blood and urine of 18 workers in a wood treatment plant during a 20-day vacation and found that the blood level dropped from 5.1 to 2.2 ppm, and the urine level dropped from 1.3 to 0.6 ppm.

The remaining workers suffered conjunctiva and chemical burns of the skin, which give a burning pain unlike other primary irritants. Thorough washing of the skin with soap and water and a 15-minute wash of the eyes should precede seeking medical assistance. There is no specific antidote of PCP poisoning.

In case of doubt as to the diagnosis, either the blood or urine can be analyzed, but it must be kept in mind that widespread use of PCP results in low levels being found in the general population. Bevenue (1967) studied urine levels in 541 people residing in Honolulu and adjacent rural areas; 130 were pest control operators; 117 were state, city, or county pest control operators; and the remainder were office workers or householders. An additional 294 were drawn from the Honolulu Heart Institute, a group representing wide socio-economic levels. The mean of pesticide operators was 1800 ppb; nonoccupationally exposed was 40 ppb. The range was wide in both groups, resulting in significant overlap. The study of the excretion rate indicated there are 2 pools; one with a $T_{1/2}$ of 15 days, the other about 100 days.

Casarett (1969) studied the urinary excretion of 2 workers, A and B, at a wood treatment plant, who inhaled a known quantity of PCP. There was a linear relationship between the percentage of the recovered dose remaining and the time after exposure. The plasma levels paralleled the urine levels to 0.1 ppm, then plateaued, while the urine levels continued to rise, suggesting a multi-compartment distribution in the body. Bevenue (1978) studied the urinary excretion of PCP in a worker who had a single severe dermal exposure. The urine level 2 days after exposure was 236 ppb; at 4 days, it was 80 ppb; and at 30 days, 23 ppb.

The excretion of PCP in rats and rabbits was studied by Deichmann (1942) who found that rabbits excrete 70 percent of orally administered pentachlorophenate in the urine in 24 hours, but rats receiving the dose intraperitoneally excrete 13 percent, metabolize 40 percent, and retain 47 percent after 24 hours. Braun (1976) using $^{14}C$ PCP orally in monkeys found the half-life for excretion was 92.4 and 40.8 hours for males and females respectively. These results indicate there is a wide species

variation in the metabolism and excretion of PCP, and a sexual variation within the species. Ahlborg (1974) found that the excretion of PCP was more rapid in the rat than in the mouse and that it was faster in both animals when given intraperitoneally than when given orally. He also found that the main metabolite in mice, rats, and man was tetrachlorohydroquonine, which was partially conjugated, as was the PCP.

The acute toxicity was studied in rats, rabbits, dogs, and guinea pigs by Deichmann (1942), who found toxic doses produced accelerated respiration, increased blood pressure, hyperpyrexia, hyperglycemia, and glycosuria. Lethal doses produced motor weakness, cardiac and motor collapse, and terminal asphyxial convulsions, with rapid onset of rigor mortis after death. Buck (1976) described the same findings in sheep and calves.

Severe intoxications have occurred in man, with over 30 deaths being recorded in the literature, almost entirely in industrial workers. Bergner (1965) reported 5 cases of PCP poisoning, 1 of them fatal. The fatal case was a worker who was dipping fabricated wood in a vat of 4.1% PCP without using gloves. He complained of anorexia, sweating, thirst, and fatigue. He was comatose on admission to the hospital; was wet with sweat. His temperature was 104°F and soon rose to 106°F before death. The autoposy showed mild renal and liver damage. Four other workers in the same plant complained of sweating, anorexia, and weight loss. Two cases had a +47% BMR. Neither the manager nor the workers realized the need for protective clothing.

Mason (1965) reported 2 fatal cases in workers exposed to the vapor and dust of PCP in a chemical plant. The first symptoms were nausea and vomiting, and death occurred the following day after developing a temperature of 107°F in 1 case and 106°F in another. The autopsy showed lung edema and congestion of the lungs and kidneys.

Armstrong (1969) and Robson (1969) reported severe illness in 9 newborn infants, with 2 deaths. They showed symptoms of diaphoresis, fever, tachycardia, tachypnea, hepatomegaly, and acidosis. Infants undergoing exchanged transfusion recovered. The cause of the poisoning was the use of PCP in the laundering of diapers in which toxic amounts of the chemical remained.

Chronic Effects

The Environmental Protection Agency, in position document 1 issued in 1978 and in position document 2/3 issued in 1981, summarized all available data on possible chronic effects of overexposure to pesticides containing commercially available pentachlorophenol. Some animal tests suggest the potential for oncogenicity, teratogenicity, and fetotoxicity in the event of excessive human exposure.

## CONCLUSIONS

Although excessive exposure in industrial settings to concentrated solutions of pentachlorophenol can result in acute poisoning and death, use as a pesticide in accordance with label instructions rarely results in overexposure and significant acute illness or injury.

The potential for chronic health effects from excess exposure has not been completely resolved, but it appears prudent to minimize exposure of users and others to the maximum extent that is practical.

## REFERENCES


1. Ahlborg, U G, J E Lindgren, M Mercier
   Metabolism of PCP
   Archiv Toxicol 32:271-281 1974

2. Armstrong, R W, E R Eichner, D E Kline, W F Barthel, J V Bennet, V Jonnson, A Bruce, and L V Lovelass
   Pentachlorophenol poisoning in a nursery for newborn infants.
   II Epidemiologic and toxicologic studies.
   J Pediat 75:317-325 1969

3. Bergner, H, P Constantinidisand J H Martin
   Industrial pentachlorophenol poisoning in Winnipeg.
   Canad Med Assoc J 92:448-451 1965

4. Bevenue, A, T H Haley and H W Klemmer
   Note on the temporary exposure of an individual to pentachlorophenol
   Bull Environ Contamination Toxicol 2:293 1967

5. Bevenue, A J, J Wilson J Casarett and A W Klemer
   A survey of PCP content in human urine
   Bull Environ Contam Toxicol 2:319-332 1967

6. Boutwell, R K and D K Bosch
   The tumor-promoting action of phenol and related compounds for mouse skin.
   Cancer Res 19:413-423 1956

7. Braun, W H and M W Sauerhoff
   The pharmacokinetic profile of pentachlorophenol in monkeys.
   Toxicol Appl Pharmacol 38:525-533 1976

8. Buck, William B, Gary Osweiler and Gary A Van Gelden
   Clinical and diagnostic veterinary toxicology
   Kendall/Hunt Publishing Company Dubuque Iowa 1976
   pp 161-163

9. Buselmaier, W, G Röhrborn and P Propping
   Comparative investigations on the mutagenecity of pesticides in mammalian test systems
   Mutat Res 21:25-26 1973

10. Casarett, L J, A Bevenue, W L Yanger, and S A Whalen
    Observations on PCP in human blood and urine
    Am Ind Hyg Assoc 30:360-366 1969

11. Deichmann, W, W Machle, K V Kitzmeller and G Thomas
    Acute and chronic effects of PCP and sodium PCP upon experimental animals.
    J PET 76:104-117 1942

12. Fahrig, R, C A Nilsson and C Rappe
    Genetic activity of chlorophenols and chlorophenol impurities
    Pentachlorphenol, Plenum Press 1978
    Pg 325

13. Gaines, T B
Acute toxicity of pesticides
Toxicol Appl Pharmacol 14:515-584 1969

14. Harrison, D L
Part 1: PCP
The N.Z. Veterinary J 7:89-93 1959

15. Hinkle, D K
Fetotoxic effects of pentachlorophenol in the Golden Syrian hamster.
Abstract: 12th Annual Meeting of the Society of Toxicology 1973

16. Hoben, H J, S A Ching, L J Casarett
A study of inhalation of PCP by rats III Inhalation toxicity study.
Environ Contam Toxicol 15:463-474 1976

17. Innes, J R M, B M Ulland, M G Valorio, L Petrucelli, L Fishbein, E R Hart, A J Pallotta, R R Bates, H L Falk, J J Gart, M Klein, L Mitchell and J Peters
Bioassay of pesticides and industrial chemicals for tumor genicity in mice, a preliminary note
J Natl Cancer Inst 42:1101-1114 1969

18. Knudsen, I, H G Verschuuren, E M Den Tonkilaar, R Kroes, and P W Helleman
Short term toxicity of PCP in rats
Toxicology 2:141-152 1974

19. Kutz, F W, R S Murphy and S S Strassman
Survey of pesticide residues and their metabolites in urine from the general population
"Pentachlorophenol", Plenum Press 1978
Pg 363

20. Larsen, R V, G S Born, W V Kessler, S T Shaw and D V Van Sickle
Placental transfer and teratology of pentachlorophenol in rats
Environ Letters 10:121-128 1975

21. Larsen, R V, L E Kirsch, S M Shaw, J E Christian and G S Born
Excretion and tissue distribution of unifromly labelled $^{14}C$ PCP in rats.
J Pharmacutical Sci 61:2004-2006 1972

22. Mason, M F, S M Wallace, E Foerster and W Drummond
Pentachlorophenol poisoning: report of two cases
J Forensic Sci 10:136-147 1965

23. Robson, A M, J M Kissane, N H Elvick and N Pundavela
Pentachlorophenol poisoning in a nursery for newborn infants
I Clinical features and treatment
J Pediat 73:309-316 1969

24. RPAR on PCP Federal Register
Vol 43 #202 Wed Oct 18, 1978
A reproductive and fetatoxic effects
Schwetz 1979

25. Schwetz, B A, P A Keeler and P J Gehring
The effect of purified and commercial grade pentachlorophenol on rat embryonal and fetal development
Toxicol Appl Pharmacol 28:151-161 1974

26. Schwetz, B A, J M Norris, C M Sparschu, V K Rowe, P J Gehring, J L Emerson and C G Gerbig
Toxicology of chlorinated dibenzo-p-dioxins
Environ Health Perspectives 5:87-99 1973

27. Schwetz, B A, J F Quast, P A Keeler, C G Humiston and R J Kociba
Results of two-year toxicity and reproduction studies on PCP in rats
"Pentachlorophenol", Plenum Press 1978
pg 301